CUTEC NEWS

FACTS · INFORMATION · ANALYSES

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Your opinion is important: cutec-news@cutec.de

Quo vadis, CUTEC?

You will certainly have heard the Latin question: "Quo vadis, Domine?" ("Where are you going, Lord?"). This is what Saint Peter, on his flight from Rome, is supposed to have asked the resurrected Christ when they met on the Via Appia. His answer caused Peter to turn back, whereupon he was arrested in Rome and crucified. Thus far the traditions. That the question "quo vadis" in conjunction with a name or an issue is still popular even today can be confirmed by typing it into an internet search engine. Google, for instance, provides several million entries in response to this request. Nowadays, however, the question is frequently used in the sense of "How will things continue in the future?". I would like to take the turn of the year as an opportunity to report on the plans and intentions of CUTEC for the New Year – and beyond. On the one hand, we are focusing on the further development of existing technologies and the improvement and intensification of known processes. As an example, the FlocFormer should be mentioned, for the marketing of which we want to found a separate company in the New Year. In Japan, the operation of a corresponding pilot plant, which was conducted in cooperation with a local enterprise, has recently come to an end. You can read the reports about this on pages 1 and 2. On the other hand, we are working vigorously on strategic approaches for the development of new technologies. Lately, we reported about our group "Fuels and chemical raw materials from biomass". On page 3 of this issue we will introduce you to a new project in this context: BioLog – the name is composed of the focal points of the project – biomass and logistics. Based on existing experience with the gasification of biomass and the subsequent synthesis of second generation fuels, we are also going to work in the future on the decentralized production of biomethane through biomass conversion in three ways: By means of gasification and synthesis, by means of fermentation and finally by coupling both processes. In order to achieve our objectives, the individual process stages need to be either redeveloped or optimised. This applies equally to process control in gasification, the simplification of gas purification technology and process control in synthesis. Especially in the case of the synthesis process, we are treading new paths in order to obtain a wide range of products.

As you can see, our maxim continues to apply in the year to come: There is a lot to do – we will tackle it! Let us start the New Year 2007 with confidence and vigour!

Yours, Otto Carlowitz

IN THIS ISSUE

2007: the first new company foundation originating from CUTEC is planned

In order to facilitate a faster market entry for CUTEC developments in the field of waste-water and sludge technology, the establishment of an independent company for production and marketing of these developments is currently being prepared. The first products that are ready for the market, the base products, are a procedure for increasing the biogas yield from municipal sewage sludge with the name "sludgePRO" and an apparatus, including the corresponding sensor technology, for improving the dewatering efficiency of dewatering machines with the designation "FlocFormer". The target customer groups are municipal and industrial plant operators in the field of waste-water and sludge treatment worldwide. The application of the products gives rise to process intensification in waste-water and sludge treatment, which allows the operator to reduce the resource and energy costs considerably and thus to run his plant more economically.

The new enterprise will probably trade as a GmbH under the name of "aqua-engineering", or "aquen" for short. The company headquarters will be in

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2007: the first new company foundation originating from CUTEC is planned

Clausthal-Zellerfeld in order to strengthen the Harz economic region and to emphasize the ties with CUTEC. Moreover, the location Clausthal-Zellerfeld with the Clausthal University of Technology as a nucleus for spin-off enterprises already has a long tradition of successful innovative companies.

Potential logo of the new company

The primary objective of the future aquen GmbH will be the worldwide marketing of the base products. The further development, the engineering and the final production, the testing and packaging of the products can be carried out in Clausthal-Zellerfeld. The necessary individual components will be manufactured and supplied by partner companies in Lower Saxony.

The secondary objective of aquen GmbH is to develop into an innovative system provider in the fields of sludge management, treatment and utilisation.

Furthermore, it is planned to establish close cooperation with CUTEC in the field of applied waste-water engineering. In this context, the aquen company with its free market access can demonstrate developments from CUTEC in their practical application and thus give impetus to important development tendencies on the market. As a further benefit, the feedback from the application on the market will indicate where there might be further potential for CUTEC for research and development in the field of environmental process engineering. (schr)

Successful pilot-plant operation with the FlocFormer in Japan

In late 2003, CUTEC established the first contacts with the Japanese enterprise Tsukishima Kikai Co., Ltd. (TSK). At the invitation of Dr. Onyeche, a meeting took place in Clausthal in 2004, at which the potential for cooperation in Japan in the field of environmental engineering was discussed. Apart from the other CUTEC projects the Japanese were particularly interested in the low-pressure homogenisation of sewage sludge and the FlocFormer.

In a preview that was published in the Japanese technical journal "SETO Monthly Review: Environmental Technology in Europe" on the occasion of the IFAT 2005, CUTEC's FlocFormer was presented as innovative conditioning technology for municipal sewage sludge dewatering. As a response to the article, there were contacts with the company TSK from Tokyo during the IFAT. Last year, CUTEC presented a FlocFormer on a technical scale at its exhibition stand.

The FlocFormer technique was developed by CUTEC with the aim of improving the dewatering of sewage sludge, which has to be pre-treated for this purpose. Flocculation of the sludge is induced using adjuvants. In the FlocFormer technique, an apparatus is used in which the flocculation process is carried out in two stages. Due to four different degrees of freedom, the FlocFormer can provide flocs that are optimised for the respective dewatering machine. That way, the dewatering of the sludge is improved, the consumption of flocculation agents is reduced, and in addition the water that is recovered during the dewatering is cleaner.

Dai Takao (TSK) and Dr.-Ing. Christian Schröder (CUTEC) analyse the flocculated sludge

On the Japanese market, the company TSK is the biggest original equipment manufacturer and supplier of plant components for waste treatment management. At the IFAT, the representatives of TSK could convince themselves of the advantages of the FlocFormer technique. Their interest was sparked. The existing contact was intensified at the ACHEMA 2006 and in Japan on the CUTEC stand at the N-Expo in Tokyo.

In Japanese waste-water treatment plants, the sewage sludge dewatering is frequently accomplished by means of belt and screw filter presses, in contrast to European plants where chiefly decanters and chamber filter presses are utilised. A general problem of the Japanese waste-

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Project BioLog: Biomass and logistics are the major issues

From the field into the tank

Biomass? – oh, yes, that is the wood that one fetches from the forest (with or without the knowledge of the local forester), saws, chops and stores as firewood. Or that one simply orders as pellets at the local fuel dealer. But are these really all the forms of "biomass" that can be imagined?

The developments for replacing traditional energy sources by carbonaceous materials are in a process of rapid evolution. Hardly anyone realizes that his household waste is, in many towns, now separated and the portion with a high calorific value is available for the production of heat and electricity. A multitude of industrial power plants are currently under construction. The so-called biomass is much more at the centre of public interest, with wood being ahead of grasses, cereal crops and residues like straw because it is easy to handle. An extensive utilisation of the latter group becomes possible if thermal utilisation takes place in fluidised beds with the corresponding process technology. Here, the economical scale is above the range of private household use. Central plants with a catchment area of approx. 50 to 250 square km are in discussion. The energy content of the biomass is to be utilised in energy carriers such as fuel, methane or basic chemicals. The transport of grasses and cereal crops as fuel meets with the difficulty that its density is low and thus the costs are high. That is exactly the starting point of a development project that has been initiated by the FNR – Agency of Renewable Resources (Gülzow). In order to open up the market of industrial-scale plants to farmers, eight applications-orientated institutions (see figure below) plan to develop to commercial viability a concept for optimal energetic utilisation that comprises coupling biogas plants and central plants and aims at maximum added value for the farmers. The concept being considered is to extract the juice from plants harvested while still green, to feed the juice into a rural fermenter for biogas generation and to dry the ligneous residue, pelletise it and to sell it as fuel (see figure above). In the project, the suitability as a source of synthesis gas for fuel production is to be investigated exemplarily, and also the suitability as a source of energy for combustion. The general focus of the project is expressed in its name: Biomass and logistics = BioLog. It is affiliated to another national joint venture: EVA. Here, the yield resulting from cultivation concepts on soils of different quality is investigated. CUTEC, as the project coordinator of BioLog will maintain the connection with EVA, take on the time scheduling and ensure trouble-free communication.

From silage to pellets

The primary technical issues of CUTEC in the context of the project are the experiments on the ArtFuel plant as well as (to a lesser extent) on the reverse-acting grate. In addition to that, the CUTEC Department of Thermal Processes is responsible for the economic assessment of the thermal utilisation in the context of the accompanying research and in cooperation with the partners ATB, IFEU and TLL. (vd)

All nine: FNR, CUTEC and the seven partners

We would like to know your opinion!

You are currently reading the 17th edition of CUTEC news. You might have our newsletter in your hands for the first time, but you may also have already informed yourself about CUTEC from some of the previous issues.

Since even good things can always get better, as everyone knows, we would like to hear your opinion. Write to us by E-mail or post (see imprint) to tell us if you like CUTEC news and give us some suggestions on what we can improve in the issues to come.

We thank you in advance for your effort.

PS: The 100th participant will receive a bottle of sparkling wine – will we have to buy one? (he)

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Authors:
Prof. Dr.-Ing. O. Carlowitz (ca)
Dipl.-Ing. R.-U. Dietrich (di)
Dr. T. Heere (he)
Dr. A. Fischer (fi)
Dipl.-Ing. A. Goronczy (go)
Dr.-Ing. C. Schröder (schr)
Dr.-Ing. S. Vodegel (vd)
W. Weber, B.A. (wb)
Dr. T. Zeller (ze)
Layout and setting: G. Wessels (wes)
Photos: Gert-E. Knochen (kn)
Production and supply:
CUTEC-Institut GmbH
Leibnizstr. 21+23
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Phone +49 5323 933-0
Fax +49 5323 933-100
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Innovative control systems

Combustion control in waste incineration

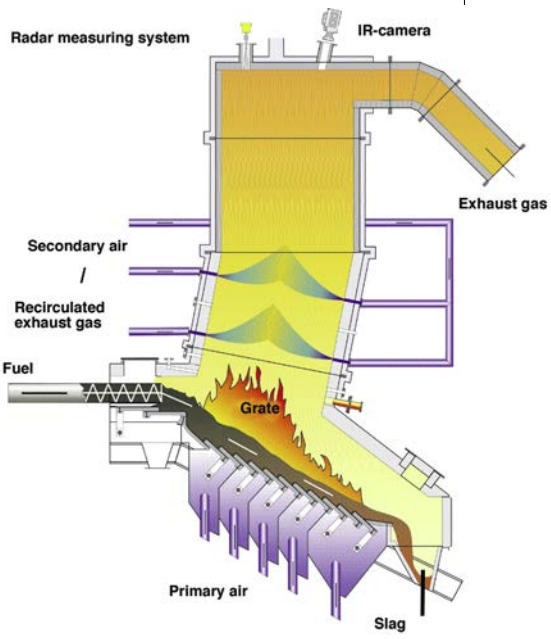
Thermal treatment represents a very widespread method for compacting municipal solid waste. For this purpose, grate firings are usually applied because of their robustness. In power stations using refuse-derived fuel, the heat that is released during combustion is first converted into steam and then utilised for district heating or for the generation of electricity. The throughput of refuse and the steam yield therefore have a great influence on the profitability of a plant. By reducing the fluctuations in power output, which arise primarily from the utilised fuel, a substantial increase in plant effectiveness can be achieved.

At CUTEC, a research project was started last year on the comparison of different combustion power control systems in grate firings. For this purpose, CUTEC is testing three different control systems on the reverse-acting grate. First of all, a conventional PID control system was set up, because the plant has been operated only manually with fixed settings up to now. In this procedure, a control value is generated on the basis of a proportional, integral und derivative terms of a measured parameter. The result of this control system is to be compared with those of the other two techniques.

Fuzzy logic is an extension of binary logic based on the values between 0 ("off") and 1 ("on"). By this means, statements such as "a little" or "much" can be processed mathematically. The actual behaviour of the fuzzy control unit is determined by if-then rules which can be specified by input from the operating staff.

As a third development procedure, artificial neural networks (ANN) will be used. Such a network is modelled on the human brain. It learns certain correlations between input and output parameters. For this, a learning phase is necessary during which a person acts as a teacher. In this phase, the ANN is taught the desired behaviour.

For the control of the reverse-acting grate, an extensive modernisation of the measurement technology and the actuative elements are being carried out. Among the measures is a radar system to determine the combustion bed height, of which the feasibility has to be tested. In addition, an infrared camera from the company MARTIN is to be integrated into the control concept.



Schematic representation of the reverse-acting grate

Infrared camera for measuring the temperature of the combustion bed

Individual days of experiments with wood and weeks of experiments with waste served to test the PID system. They showed that there is still considerable need for optimisation in the implementation of the conventional combustion power control. In principle, the function of the combustion power control could be proved during the trial weeks. Due to the fairly small grate geometry, however, performance fluctuations still occur as a result of the variability in fuel composition. Current fields of activity are the coupling of the grate with the charging unit as well as the problem of how to keep the amount of exhaust gas as constant as possible.

(go)

Further international activities of CUTEC in autumn 2006

The visitors from Doha in front of CUTEC

World Water Congress in Beijing, China

The last World Water Congress and Exhibition organized and sponsored by IWA (International Water Association) took place in Beijing from 10th to 14th September 2006. CUTEC was represented in China by Dr.-Ing. M. Sievers, Head of the Department Physical and Biological Processes, and Dr.-Ing. T. Onyeche, Manager International Operations. The congress provided more than 3,500 international delegates from industry, academic and research institutions the opportunity to network and exchange knowledge in all aspects of water cycle as well as the forum to share appropriate market information and develop new strategies.

Delegation from Qatar visits CUTEC

The visit of a three-member delegation from Qatar's capital Doha offered an opportunity to intensify CUTEC's activi-

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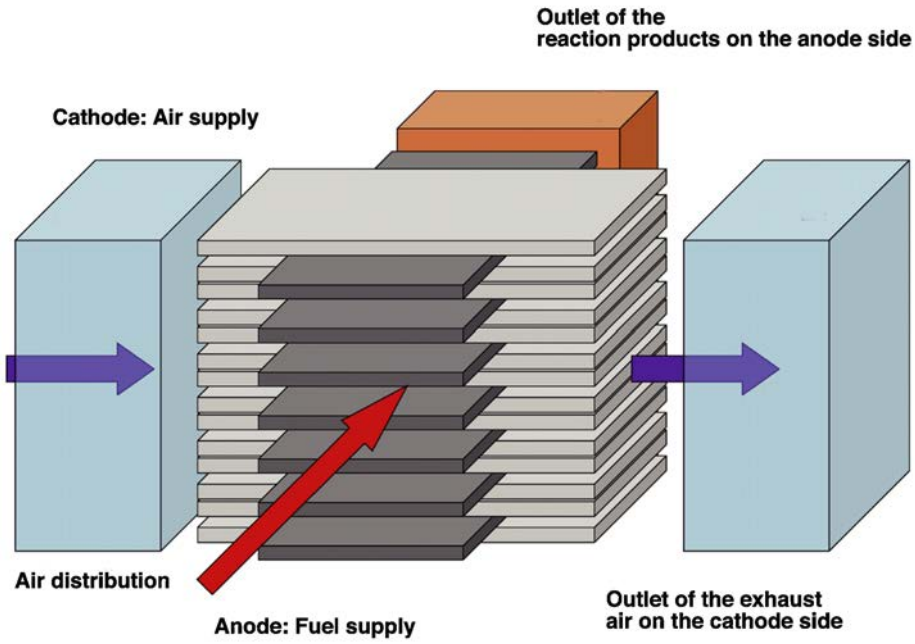
Development and testing of a high temperature fuel cell (SOFC) with parallel system architecture

CUTEC is responsible for coordinating the competence group "Science and SOFC development" of the Fuel Cell Initiative in the Federal State of Lower Saxony, and we are also active in our own projects in the field of fuel cell research, together with Clausthal University of Technology and business partners such as the company H.C. Starck GmbH in Goslar.

A new, independent project has the title "development and testing of a high temperature fuel cell (SOFC) with parallel system architecture". The project partners of CUTEC are GEA-Ecoflex GmbH in Sarstedt and several institutes of Clausthal University of Technology: The Institute of Metallurgy, the Institute of Welding and Machining and the Institute of Electrical Power Engineering. In addition, the project receives substantial support from the company EWE AG in Oldenburg.

The project is based on the long history of work with the SOFC fuel cell at the institutes of Clausthal University of Technology and on the know-how of the CUTEC institute. In this context, the design of a high temperature fuel cell (SOFC) with parallel system architecture has been developed (see figure below). The term "parallel system architecture" means that the cells of an individual stack are not connected in series, but in parallel. You are probably familiar with the series connection of light bulbs From Christmas tree illumination. If you unscrew one bulb, you are sitting in the dark. If one bulb of a set connected in parallel fails, it only gets slightly darker because the others remain illuminated. Thus, the system as a whole is more reliable.

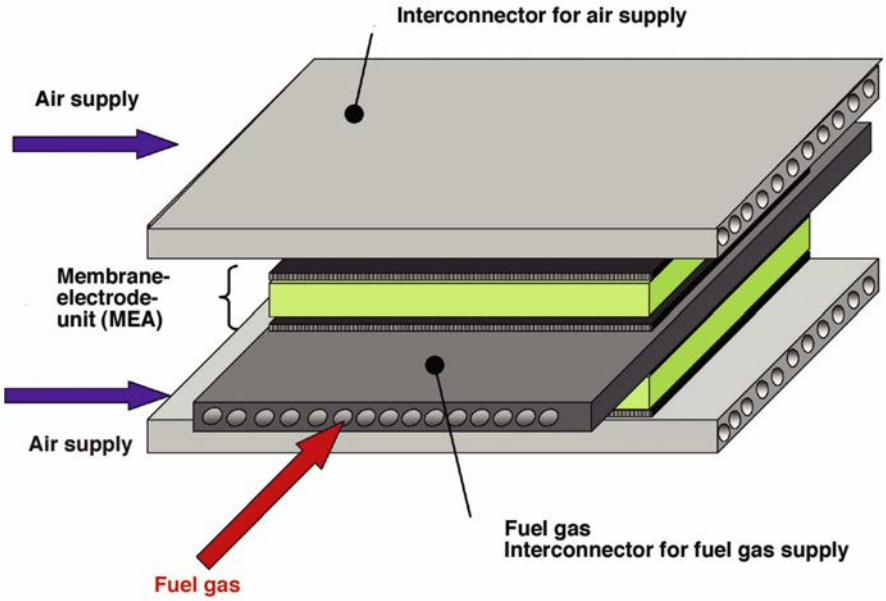


SOFC-Stack from single cells in parallel connection

Beyond that, the innovative overall approach reduces the well-known problems of other fuel cell types with respect to gas impermeability, electrical power reduction due to degradation, temperature management in the system at temperatures from 750 to 950 °C as well as excessive system and operation costs. A patent on the idea has already been applied for at the German Patent Office.

For cell construction, the basic materials used are those well-known for SOFC-cells. They are already available on an industrial scale in a consistent quality and their properties have been investigated extensively. Yttrium-stabilised zirkonium oxide (YSZ) serves as the electrolyte. The anodes used are made from nickel-YSZ-cermet, the cathodes from $La_{1-x}Sr_xMnO_3$ (LSM). The supply and removal of the fuel gas and the oxidator (air), as well as the electric flow, take place via the correspondingly structured chrome steel interconnectors. The individual cells are layered in such a way that the cathodic and the anodic interconnectors are rotated through 90 degrees in relation to each other. In this way, it is possible using simple constructive measures to use the gas supply ducts for the fuel gas and for the oxidator as current collectors.

If we succeed in producing such a stack with a longer life and increased reliability by the end of the project, one of the major obstacles to a successful market introduction of fuel cell technology will have been overcome. Our objective is the joint marketing of this technology under the overall control of GEA-Ecoflex GmbH and EWE AG. (di)



Structure of the novel single SOFC cell

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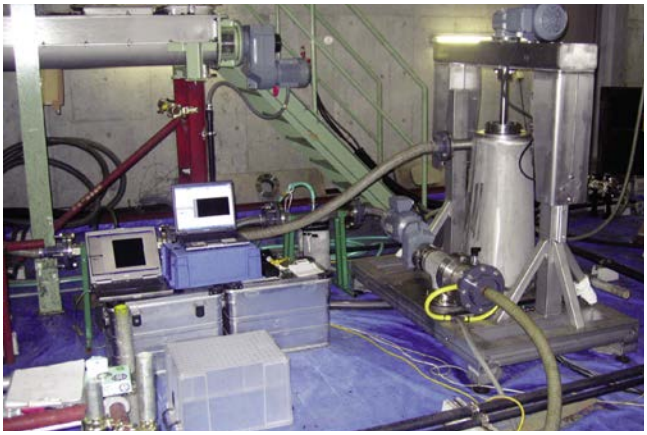
Successful pilot-plant operation with the FlocFormer in Japan



Pilot-plant in Kyoto

water treatment plants is their comparatively low dewatering efficiency at a very high consumption of flocculation agents.

In order to address these difficulties, TSK is currently, and successfully, testing a new type of dewatering machine in a twelve-month pilot-plant operation in a large-scale waste-water treatment plant in the Kyoto prefecture. In order to increase the dewatering efficiency even further, CUTEC was engaged to add a FlocFormer as an upstream conditioning stage in a two-week trial. The results exceeded all expectations: Polymer consumption could be reduced by up to 45 % at constant dewatering efficiency. The polymer reduction still amounted to up to 30 % in combination with a significant increase in dewatering efficiency.

Based on these first results, longer-term cooperation between CUTEC and Tsukishima Kikai Co., Ltd. is now planned in the field of waste-water and sludge treatment. (schr)

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Further international activities of CUTEC in autumn 2006

ties in this region.

The delegation was made up of Mr Kazzem Al Najjar, Mr Ahmed Sharif and Mr Khalid Al Khayareen of Public Works Authority Ashghal, an organisation responsible for infrastructure-related projects as well as public utilities. During their visit, the delegation was intimated with CUTEC's major operational and interest areas with tours of two nearby waste-water treatment plants. The delegation was highly impressed by the unique technologies and processes showcased by the CUTEC team. This important visit is a basis for a cooperation between the two institutions for instance in the fields of wastewater treatment, consulting, environmental studies, process optimisation of waste treatment plants or training of engineers on environmental and energy technologies.

Business delegation to Brazil and Argentina with Minister Hirche

Upon invitation by Mr Walter Hirche, Minister of Economic Affairs of the German state of Lower Saxony, Dr. Onyeche participated in a business delegation trip to Brazil and Argentina from 25th September to 3rd October 2006. During the trip several local companies were visited, among them Volkswagen do Brasil and the investment bank Caixa RS and the delegation was received by the German General Consul Hermann Erath and the German Ambassador Rolf Schumacher.

The trip provided CUTEC with an insight into the Brazilian and Argentinean environmental market and thus potential areas of cooperation could be identified. Brazil requires technologies for treatment and disposal of solid wastes since only a small percentage of the accumulated waste is disposed safely. Market opportunities also include technologies for treatment of industrial and municipal wastewater. Although the situation is different in Argentina, where most of the waste is disposed on landfills outside the city of Buenos Aires, it still contains contaminants that pollute the groundwater.

In Argentina, from left: Michael Wohlberedt, Managing Director of Intervac Vakuumtechnik GmbH; Minister Walter Hirche; Dr. Theodore Onyeche, CUTEC-Institut GmbH

These problems were discussed with local companies during cooperation exchange events in Porto Alegre, Brazil and Buenos Aires, Argentina. They were very interested in the technologies and processes provided by CUTEC and are willing to cooperate in the field of environmental engineering.

Big 5 Show 2006 in Dubai, UAE

After 2004, CUTEC exhibited for the 2nd time at the Big 5 Show in Dubai, which took place from 28th October to 2nd November 2006. Dr. Onyeche, Manager of CUTEC's international activities and Ms. W. Weber, who works as his assistant, represented the institute. In the meantime not only the number of exhibitors and visitors has increased but also the importance of the environmental sector.

The Big 5 2006 was the largest building and water technology fair ever held in the Middle East and 70% of the exhibitors present rated the visitor quality good or excellent. The CUTEC booth attracted lots of visitors from the Middle East, but also environmental representatives from India and Africa showed special interest in CUTEC's unique environmental services and sustainable technologies.

Therefore Dr. Onyeche was very pleased with the results of the trade fair since it was a perfect opportunity to study the environmental market in the Middle East and to intensify already existing contacts and establish new ones with potential clients in the environmental sector. (wb)

We present: The Department of Chemical Analytics

Tar! For many, this word brings to mind the idea of road construction or filterless cigarettes. For the staff of the Department of Chemical Analytics, however, it stands for a series of interesting as well as strenuous samplings at the pilot plants of the Department of Thermal Processes. The amount of condensate accumulating during pyrolysis, gasification or combustion of biomass is an important gauge of the practicability, environmental friendliness and efficiency of the respective method. Today the determination of tar and hydrogen sulphide, tomorrow single compound analyses in the exhaust air from industrial plants, and "in between" determinations of the heavy metal content of sewage sludge and biosolids. The wealth of projects that are worked on at CUTEC generates an endless range of challenges for the Analytics Department. Hardly any task in the field of chemical analytics resembles another, the choice and adaptation of suitable techniques and the development of new methods are constantly required. The experienced members of the analytics department are never bored, even less so since the measuring unit according to § 26 BImSchG (a federal pollution act) found a new home in the department.

The measuring unit uses mobile, continuously operating measurement technology as well as discontinuous techniques that are carried out partly on site and partly in the analytics laboratory. Relevant and frequently determined parameters include, for example, inorganic gases such as ammonia, dust emissions and dust constituents, and also organic compounds. The measurement data obtained shows the customers in and outside CUTEC whether their emissions are within the limits of the legal regulations. Quite frequently, however, the results of the analyses can also provide the experienced process engineer with important indications of the condition of their plant and of its energetic and material optimisation. This synergistic effect between the measurement unit and the other departments of CUTEC is an example of the high degree of interdisciplinary cooperation in our institute.

Varied and colourful as the tasks described above may be, there is a glimmer in the eyes of the analysts when the conversation turns to the projects which they run on their own authority: Here, the members of staff, who have been trained as laboratory assistants in chemistry or environmental technology and qualified chemists, deal with corrosion processes on heat exchangers and in waste incineration plants. Various test items are exposed to realistically simulated atmospheres or media over longer time periods in order to obtain information about the durability of different materials.

Dr. Axel Fischer and his colleagues, from left: Carmen Kiefer, Isabella Legzdins, Beate Firneisen, Dr.-Ing. Sabine Weineck and Kristina Filip

The development of resource-saving techniques is one way to exercise responsibility for society as a whole, the provision of traineeships is another: Since September 1st, the Department of Chemical Analytics has also been meeting this obligation (see report below). (fi)

Training at CUTEC

Today: Ms Isabella Legzdins from the Analytics Department

If it goes bang and stinks, it's chemistry, if it doesn't work, it's physics! Let us hope that there is not too much substance to this old saying, because for Isabella Legzdins, the good command of modern methods in chemical analysis is an important part of her training as a laboratory assistant. However, these "delicacies" are still quite rare at the beginning of her training period. It is rather the learning of basic working techniques that is in the foreground during the first year of training - seemingly trivial tasks like the weighing of substances are as tricky as the precise preparation of a dilution series. Even though almost all the glass equipment that is needed by chemists can be bought, a basic course in glass machining is still an important part of the first training stage. Woe betide anyone who does not remember that hot and cold glass look alike! Glass devices are also used for a method of volumetric analysis that is frequently used in chemistry: Titration. Here, it is really practice that makes perfect. Apart from a steady hand, a keen eye and patience are the main qualities required of Ms Legzdins for the reliable recognition of the end point.

The course of her training is regularly supplemented with the special, practical tasks of her department during sampling campaigns in the course of projects run by the operative departments. In the institute's halls, many of the individually learned working techniques can be consolidated under realistic conditions, and

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Training at CUTEC

Experience meets interest: C. Kiefer explains I. Legzdins the procedure of fully automatic nitrogen determination

thus their systematic place within a compound method can be recognised.

The good cooperation within the CUTEC institute showed up once more in the inter-departmental training: Recently, the Department of Physical and Biological Processes organised a one-week practical course on microbiological topics. Thus, knowledge from the area bordering two scientific disciplines was imparted. At a later date, Ms Legzdins, together with trainees from other sectors, will take part in a course run by the Department of Chemical Processes. Thereby, the ability to think and work in a team-oriented and interdisciplinary way will have been aroused and encouraged in the first year of training. After her successful start, we wish Ms Legzdins further success for her career and enjoyment in her training. (fi)

News from the CUTEC team

On 1st October 2006, Dipl.-Ing (FH) Rainer Sibbe went into well-deserved retirement. When he started working at CUTEC on 1st December 1993, the CUTEC building was still in the planning stage. One of his first tasks was to coordinate the building operations and to monitor their progress, together with Dipl.-Ing. Werner Siemers. After CUTEC moved into the building, he became active in two functions: He was in charge of the technical facilities and he also acted as a safety engineer. We thank him for his dedicated and competent work over a period of almost thirteen years.

The activities in the field of working safety will be taken on by Mr Jörg Cronjäger in the future.

For more than fourteen years, Dipl.-Ing. (FH) Dietmar Starke has been a construction engineer for CUTEC. In the context of the project for partial retirement, the release phase started for him on 1st December 2006. We thank him as well for his commitment and services rendered.

We wish both of them all the best for the future.
(he/wes)

Rainer Sibbe (r.) and Jörg Cronjäger

Report of the works council

The process of the further development of the company is promoted continuously. For example, at the suggestion of the steering committee, Prof. Carlowitz, the staff and the works council have discussed, voted on and adopted a code of conduct. In this context, the development of the colleagues according to the principle "support and challenge" is a vital element of CUTEC's corporate culture. With regard to the up-and-coming generation of young scientists, the support of those working on doctorates is a particularly urgent concern. For this purpose, the young scientists are developing a draft of a doctorate agreement that has been suggested by the steering committee. Of course, the empowerment of the colleagues also includes non-scientific areas. For example, three colleagues are currently taking part in training courses that will allow them to perform more qualified duties. With the replacement of the old national employee pay tariff agreement "BAT" by the new "TV-L" scheme on 1st November 2006, possibilities for a more performance-related remuneration system have been opened up. (ze)